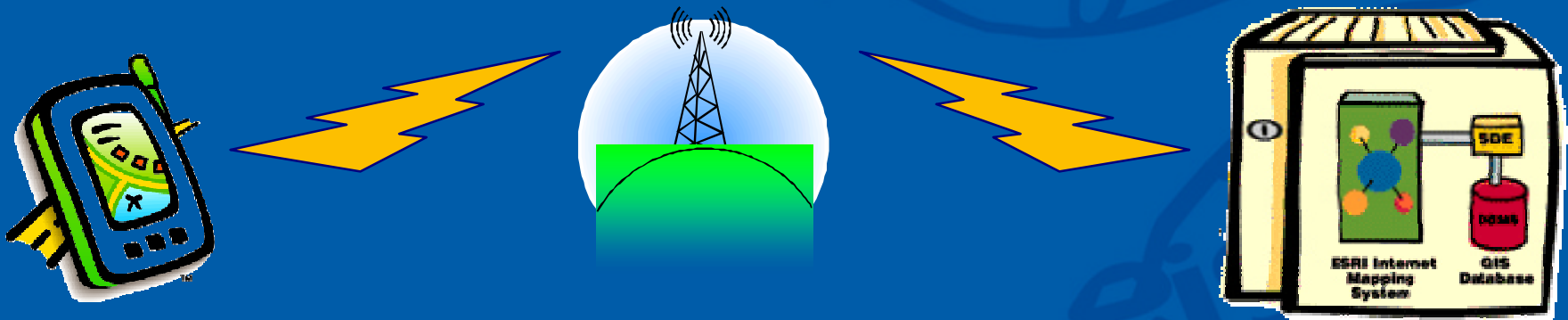


ESRI Mobile GIS Solutions

Eric Butler
ESRI - Denver

What is Mobile GIS?

- Mobile GIS is a component of an Enterprise IT implementation that facilitates the use of hand-held or mobile computer systems in the field to enable workers to share corporate data and geographic services often in real-time.



ESRI Mobile Products

- **ArcPad**
 - Mobile GIS and field mapping for handheld & mobile systems
 - **ArcGIS Desktop**
 - Tablet PC support
 - Publisher extension – Free ArcReader application
 - **ArcEngine custom application**
 - Custom stand-alone ArcObjects application developed specifically for field use
-
- **ArcIMS & ArcGIS Server**
 - Provide map services that clients can consume if connected via wireless

Windows Mobile Devices

Pocket PC



Industrial



Handheld GPS



Tablet PC



Laptop HPC



Rugged
Field CE



Rugged PC



Phone



Planning

- Who is the target field user?
- What is the field environment?
- What task(s) will be performed?
 - How often?
 - How urgent?
 - Regional or local?
 - Vehicle-based or on-foot?
- Will a custom application be needed?
- What data will be used in the field?
 - Type of data (vector, raster, layers, formats)
 - Projections and datums
 - Size of data
 - Display of data (symbolology)
- What equipment will be needed?
- What is the budget for:
 - Equipment?
 - Labor?
 - Equipment failure and mistakes?



Mobile Device Considerations

- Screen size
 - Determines mobile device size, weight, battery life
 - Smaller screens:
 - Field tasks that focus on a small, local area
 - Larger screens:
 - Fields tasks that focus on a large, regional area
- Means of transport
 - Determines power needs, device size and weight
 - Predominantly vehicle-based
 - Predominantly on foot
- Integrated GPS
- Ruggedness
- Keyboard
- Wireless (Bluetooth, WiFi, WAN)

Mobile Device Determining Factors

Application Needs

Smaller screen

Larger screen

Weight

Size

Battery Life

OS

Lighter

Smaller

Longer

WM/CE

Heavier

Larger

Shorter

XP

Means of Transport

Vehicle based

Foot based

Screen Size

Weight

Size

Battery Life

OS

Larger

Less Important

Less Important

Less Important

XP

Smaller

Lighter

Smaller

All day

WM/CE



Software Considerations

- User Interface
- Open Architecture
- Data Sources
- Editing Capabilities
- Analysis Functions
- Deployment Cost

helping
manage our
world

ArcPad 7



Overview - What is ArcPad?

- Mobile GIS and field mapping
 - For handheld & mobile systems
- Field-based GIS tasks
 - Inventory
 - Monitoring
 - Surveys
 - Inspections
 - Reporting
 - Data validation
 - Mapping
- Part of Enterprise ArcGIS solution



ArcPad Status

- ArcPad 6.0.3 QFE patch (January, 2005)
 - Download from support.esri.com/arcpad
 - Addresses issues with Windows Mobile 2003 SE
- ArcPad 7.0
ArcPad Application Builder 7.0
 - Final release November, 2005

ArcPad 7 System Requirements

- Desktop PC
 - Windows XP/XP Tablet PC Edition, 2000
 - Microsoft ActiveSync 3.7 or higher (latest version, 3.8, recommended)
- Windows Mobile and Windows CE devices
 - Windows CE 4.2
 - Windows Mobile 2003, 2003 SE
 - Supported CPU chips:
 - ARM-based (e.g. Atmel, Intel StrongARM and XScale, Samsung, Texas Instruments OMAP)
 - RAM: 32MB minimum (64MB or 128MB recommended)

Supported Data Formats

- Vector
 - Shapefile (including spatial and attribute* indices)
 - Graphics Layer *
- Raster
 - TIFF (including GeoTIFF) *
 - JPEG2000 *
 - MrSID (MG2)
 - JPEG
 - PNG
 - BMP
 - GIF
 - CADRG
 - (header* / .aux* / .prj / .worldfile)
- ArcIMS Image Service
 - Open or protected* services
- Photo Layer *
- Georeferenced photos
- GPS protocols
- Rangefinder protocols *
- Custom data formats

(* = New at ArcPad 7.0)

Preparing Data for ArcPad

- Create new data in ArcPad
 - New shapefiles
 - New input forms with QuickForm tool *
- Use existing shapefiles
 - Create ArcPad 7 symbology files
 - Create input forms with QuickForm tool *, or ArcPad Application Builder
- Extract data from geodatabase
 - Input forms created automatically
- For faster performance
 - Use shapefile indexes (spatial and attribute)
 - Use scale dependent symbology and labeling

Editing geodatabase data with ArcPad

1. Create geodatabase version
2. Extract data to “smart” shapefiles
3. Copy data from PC to mobile device
4. Make edits in ArcPad
 - Enforcement of GDB rules limited to shapefile and ArcPad functionality
 - Attribute rules are supported
 - Geometry rules are not supported
5. Synchronize data from mobile device with PC
6. Update the geodatabase version

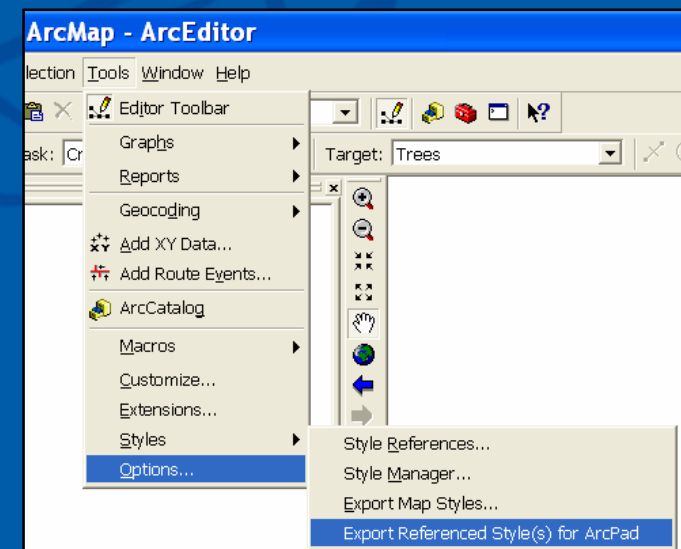
ArcPad toolbar in ArcMap

- Get data for ArcPad
 - Copies all data to new folder
 - Checks out geodatabase layers for editing in ArcPad
 - Automatically creates custom edit forms, with
 - Associated scripts
 - Dropdown list for domain and sub-type values
 - Min/max values
 - Converts all vector data to shapefiles
 - Creates ArcPad 6 symbology files
 - Converts all raster data to MrSID
 - Get data for ArcPad 7 *
 - Same as Get data for ArcPad tool
 - Creates ArcPad 7 symbology files
- (* = Additional tools installed with ArcPad 7.)



ArcPad toolbar in ArcMap (continued)

- Check in edits made in ArcPad
 - Option to undo/release check out
 - Export symbology for shapefiles *
 - Creates ArcPad 7 symbology files for selected shapefiles
 - Does not copy shapefiles
 - Export and Import graphics layer to/from ArcPad 7 *
 - Export style sheets for ArcPad 7 *
 - **ArcPad toolbar included with ArcMap at ArcGIS 8.3/9.x.**
- (* = Additional tools installed with ArcPad 7.)



Enterprise GIS/GPS Data Capture

Traditional GPS approach

- Define data dictionary (sometimes in the field)
- Capture data “in isolation”
- Send data to GIS department
- GIS department uses (custom) tools to validate data

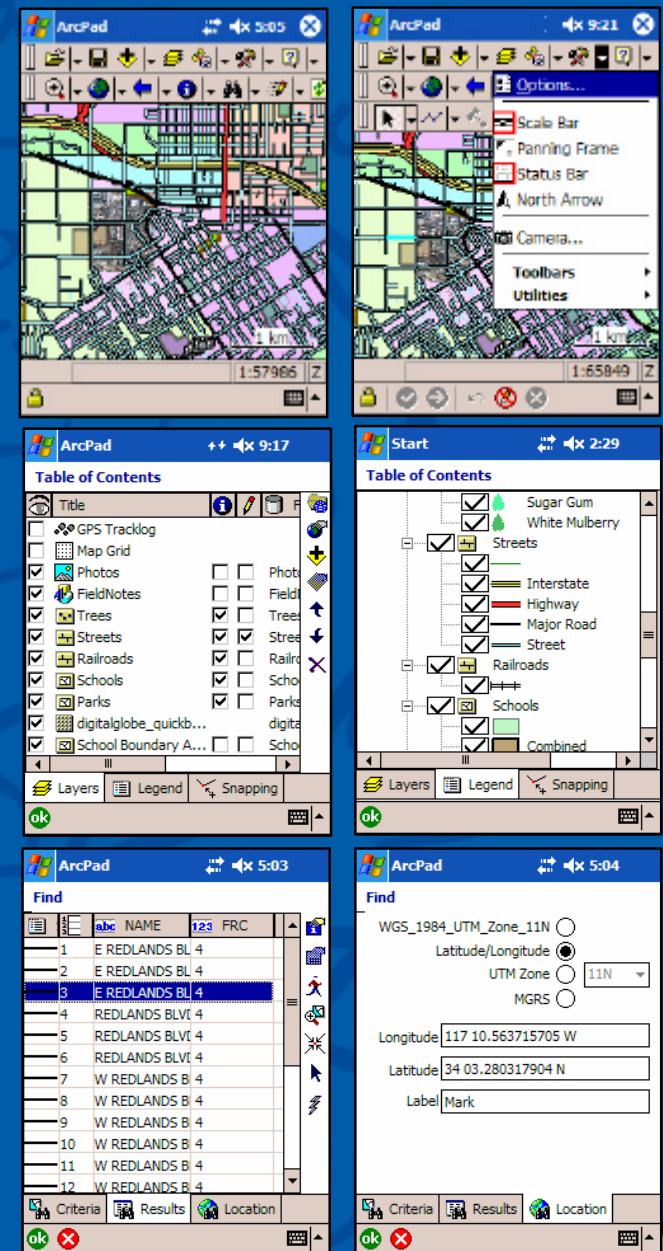
Less standardization
High probability of errors

Enterprise GIS approach

- Design and create geodatabase
- Extract data
 - Schema or data to be edited
 - Reference data
- Capture data
 - Attribute rules validated
 - Spatial rules implicitly validated with use of reference data
- Send data to GIS dept.
- GIS dept. checks in and validates data using standard tools

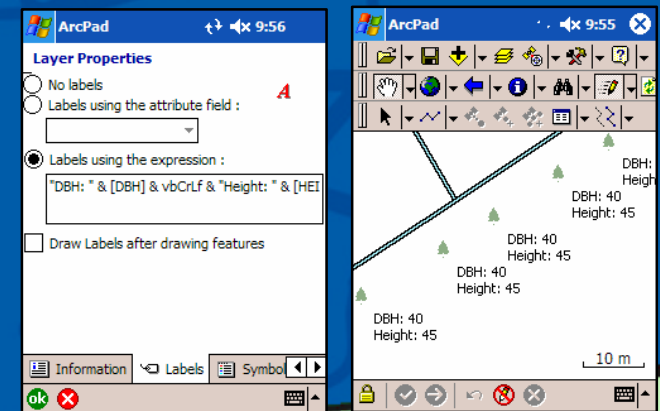
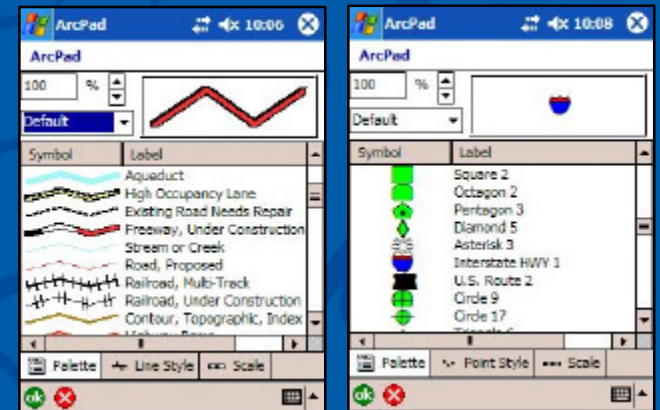
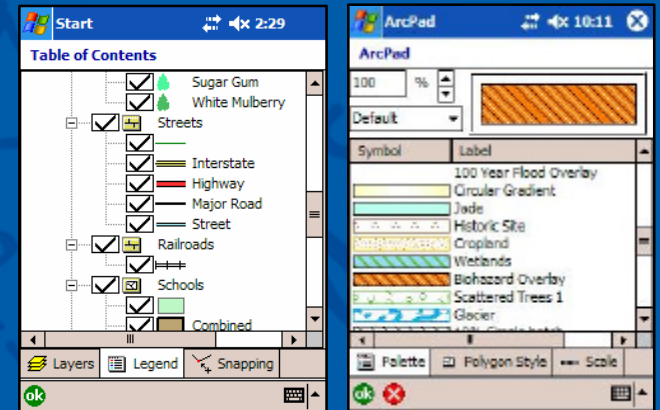
Basics

- Map interface
 - Multiple data formats
 - Multiple vector and raster layers
 - Table of Contents
 - Scale bar, north arrow
- Rich toolset
 - Identify, Find, Measure, Hyperlink, Go To
- Map navigation
 - Pan, zoom, spatial bookmarks, automatic map rotation
- Customizable



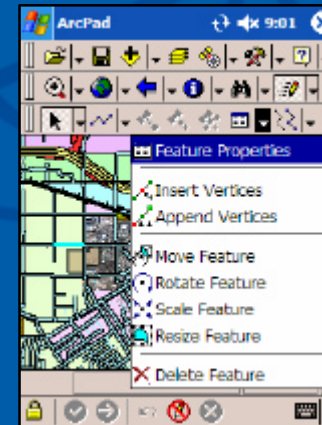
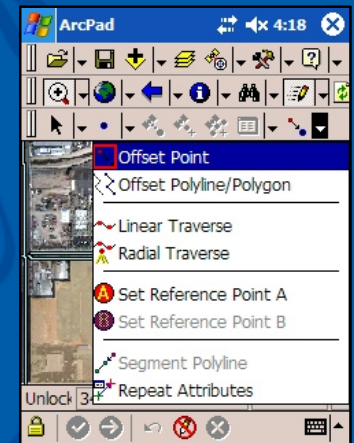
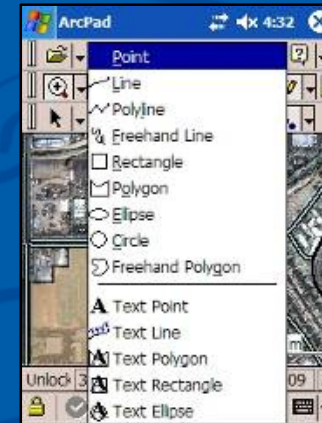
Symbology

- Map legend in TOC *
- Symbol editors *
 - Style sheets can be imported from ArcGIS
- Complex line symbols *
 - Hash, marker, pattern strings, end arrows, offsets
- Complex polygon symbols *
- Marker, line, gradient, raster fill types
- Composite marker symbols *
- Transparency *
- Labeling
 - Placement options for point and line labels *
 - Label expressions *



Data Capture and Editing

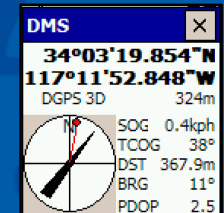
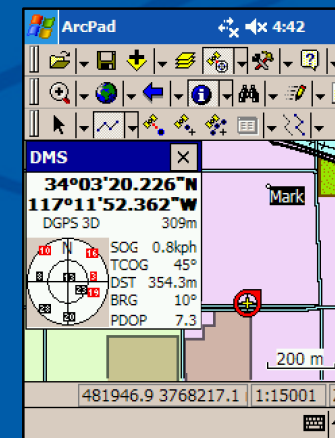
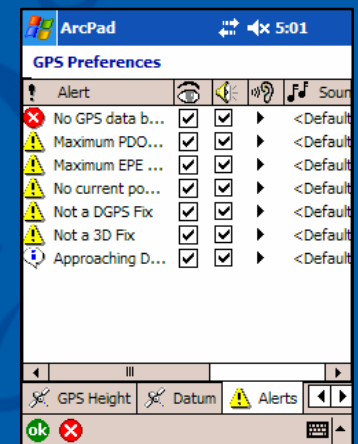
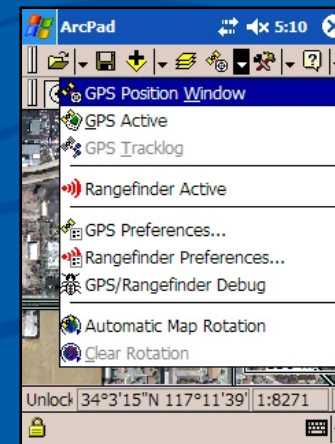
- Data capture
 - Point, line, polygon, text
 - Geometry, attributes
 - Existing or new features
 - Pen, GPS, rangefinder, coordinates
- Editing tools
 - Insert, append, move vertices
 - Move, rotate, scale, resize features
 - Snapping *
 - Undo *
 - Offsets for points, vertices *
 - Left/right offsets for lines, polygons *
 - Linear and radial traverse *
 - Repeated attributes *
 - Segmented line features *
- Editing of Graphics layer
 - Field sketches and notes



ArcPad 7 Demo

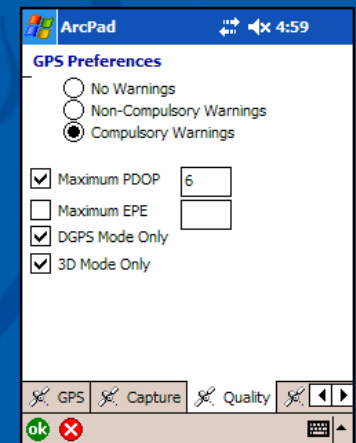
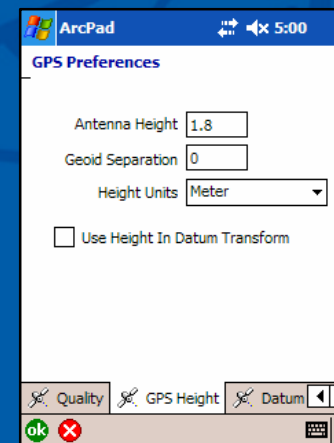
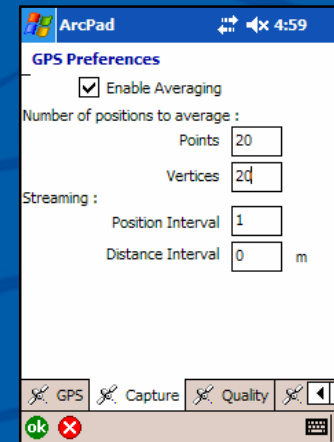
Using a GPS

- Set GPS preferences
 - Capture options
 - Quality options
 - Alerts
 - GPS height *
- Activate GPS
- Activate GPS Tracklog
- View GPS Position Window
- Select feature to edit
- Select GPS capture tool
 - GPS point capture
 - GPS vertex capture
 - GPS streaming vertices capture



GPS Capture, Quality, Height Options

- Capture Options
 - Averaging for points, vertices
 - Streaming position interval
 - Streaming distance interval *
- Quality Options
 - Warnings
 - Compulsory, non-compulsory
 - Maximum PDOP
 - Maximum EPE
 - DGPS mode only
 - 3D mode only
- GPS Height *
 - Antenna height
 - Geoid separation



Supported GPS Receivers

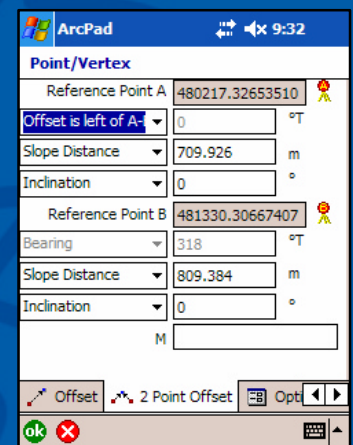
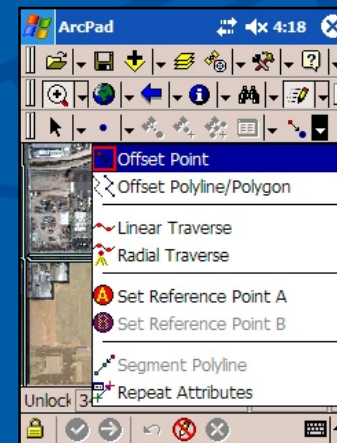
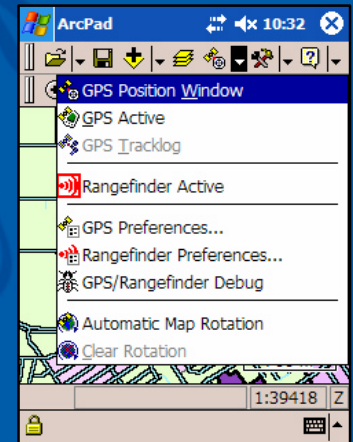
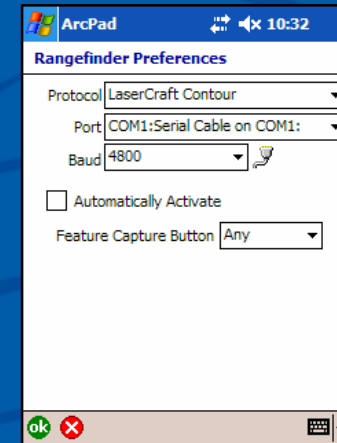
- GPS Protocols
 - NMEA
 - TSIP
 - PLGR
 - Earthmate
- Custom GPS extensions

Selecting a GPS Receiver

- Required accuracy
 - Autonomous?
 - Real-time differential correction?
 - Post-processed differential correction?
- GPS design
 - Accuracy proportional to antenna size
 - Accuracy related to cost of device
 - Accuracy related to intended market
 - Fix at any cost
 - No fix preferable over poor quality fix
- Field conditions
 - Open environment?
 - Canopy?
 - Urban canyons?
 - Multipath errors?
- Ease of use
 - Handheld
 - Backpack
 - Bluetooth
 - Integrated GPS and mobile device
- Vendor support
- Budget
- Battery / power needs

Using a Rangefinder *

- Set rangefinder preferences
- Activate rangefinder
- Select feature to edit
- Select offset type
 - Offset point
 - Linear or radial traverse
 - Set reference point(s)
- Take offset measurements
 - Distance-Bearing
 - Distance-Distance
 - Bearing-Bearing
 - Foresight, backsight

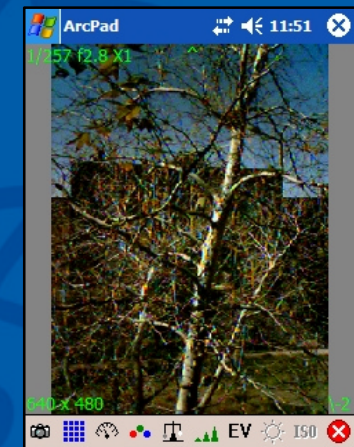
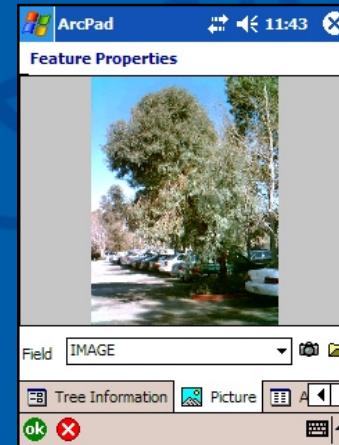
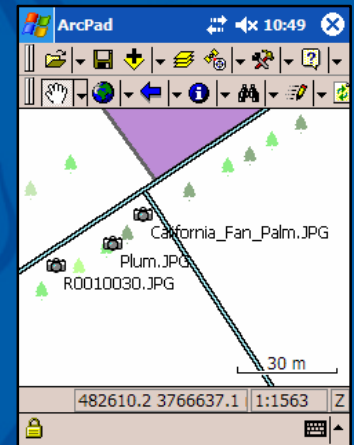
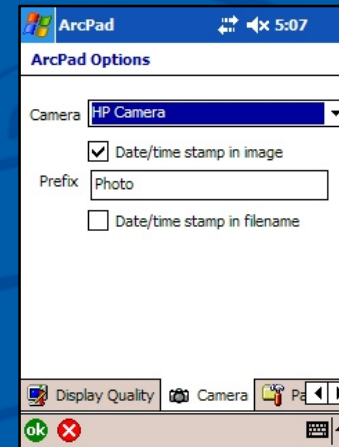


Supported Rangefinders

- Laser Atlanta (Advantage)
- LaserCraft (Contour)
- Laser Technology (Impulse)
- MDL (LaserAce)
- Leica (Disto, Vector/Locator)
- Custom rangefinder extensions

Using a Camera *

- Set camera options
 - Filename prefix and suffix
 - Date/Time stamp in image
- Take photos
 - Camera tool for standalone photos
 - Camera tool on Picture page (Feature Properties)
 - EXIF support
- View photos
 - Photo layer of georeferenced photos
 - Identify tool to view Picture page
 - Hyperlink tool



Supported Cameras

- PC
 - PC-Cams / Webcams via standard Windows camera API
- Windows Mobile
 - HP iPAQ rx37xx, h63xx integrated cameras
- Custom camera extensions

Summary: Using ArcPad

1. Add data to ArcPad map
 - Create new data
 - Existing data from GIS database
2. Set options
 - ArcPad options and map properties
 - GPS capture and alerts
 - Camera
 - Rangefinder
3. Select layers to edit
4. Capture data with pen, GPS, rangefinder, camera
5. Enter feature attributes
6. (Edit existing features)
7. Update GIS database

Tips

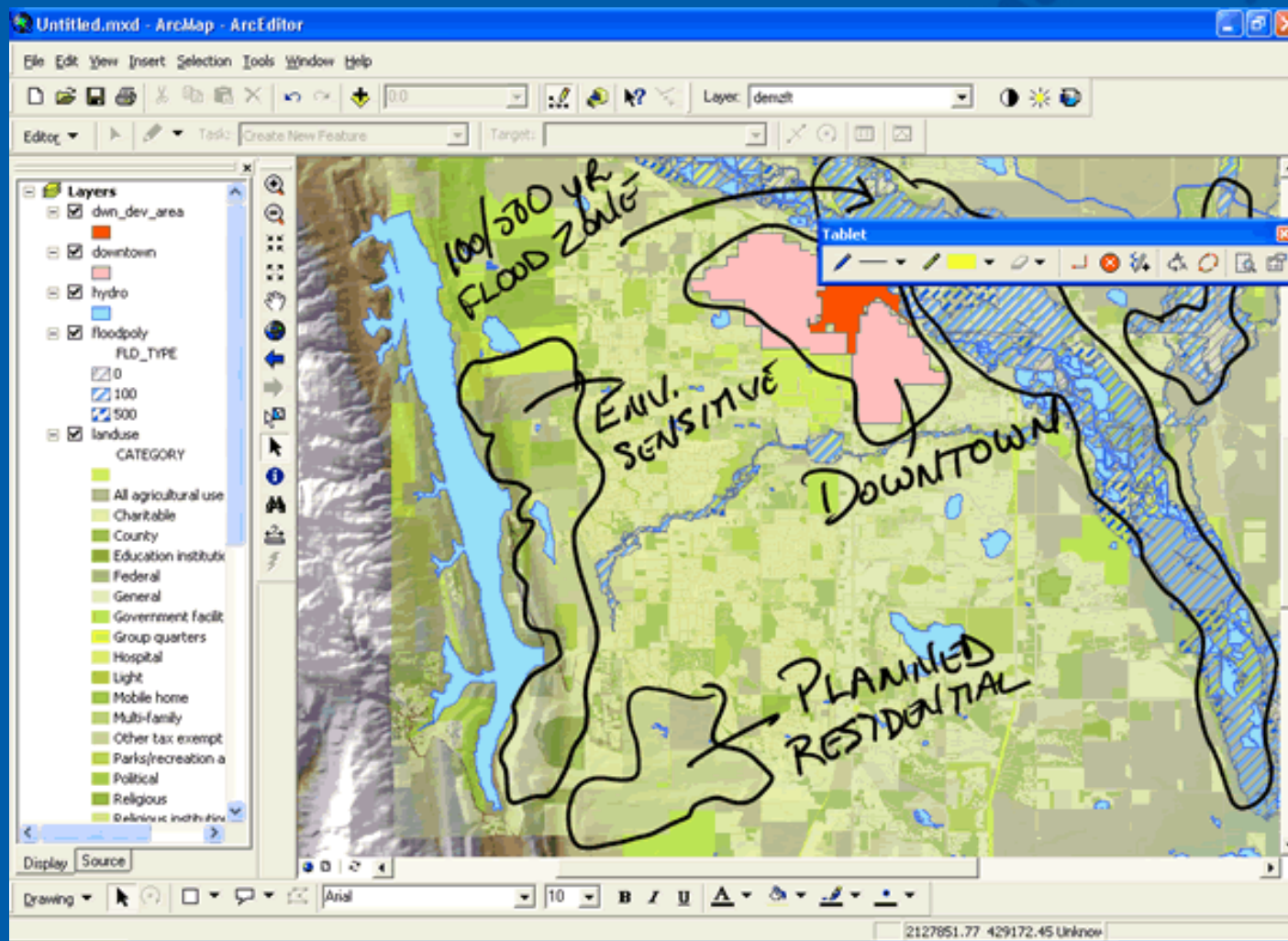
- Be pragmatic - just because it's possible, doesn't make it practical.
- Be realistic - the perfect device/GPS does not exist, and probably never will.
- Keep it simple
- Performance
 - Limit data volume to what is really needed
 - Use spatial and attribute indices
 - Use scale dependent symbology and labeling
- Use custom forms and toolbars
 - Increased efficiency of field users
 - Increased accuracy of attribute data

ArcPad Resources

- ArcPad web page (esri.com/arcpad)
 - Evaluation software
 - ArcPad Templates
 - Third Party extensions (Related Products)
- ArcPad online support (support.esri.com)
- ArcPad Discussion Forum
(Accessed via ArcPad online support)
- ArcPad Knowledge Base (support.esri.com)
- ArcScripts (arcscripts.esri.com)

ArcGIS Desktop

Tablet PC Tools for ArcGIS



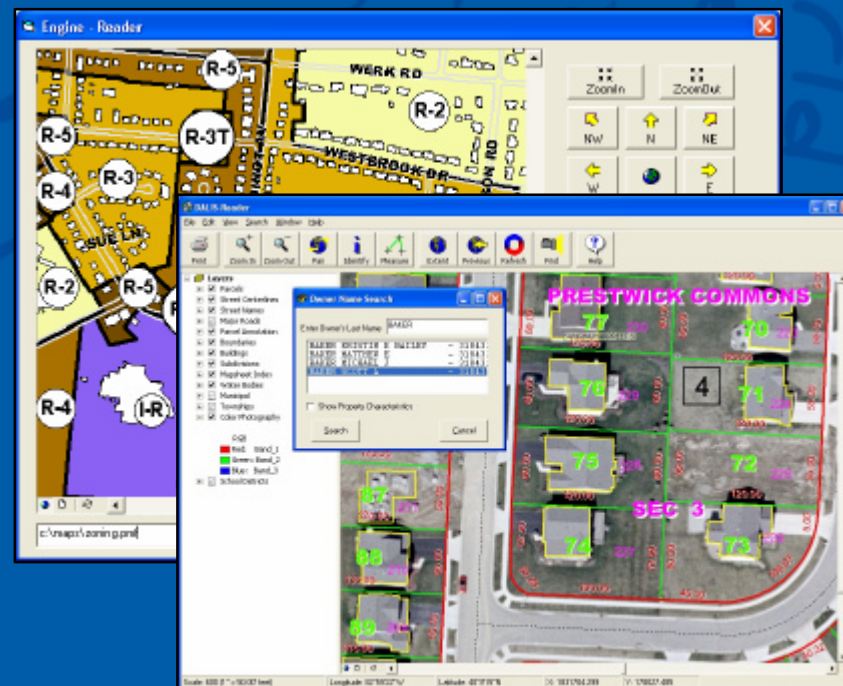
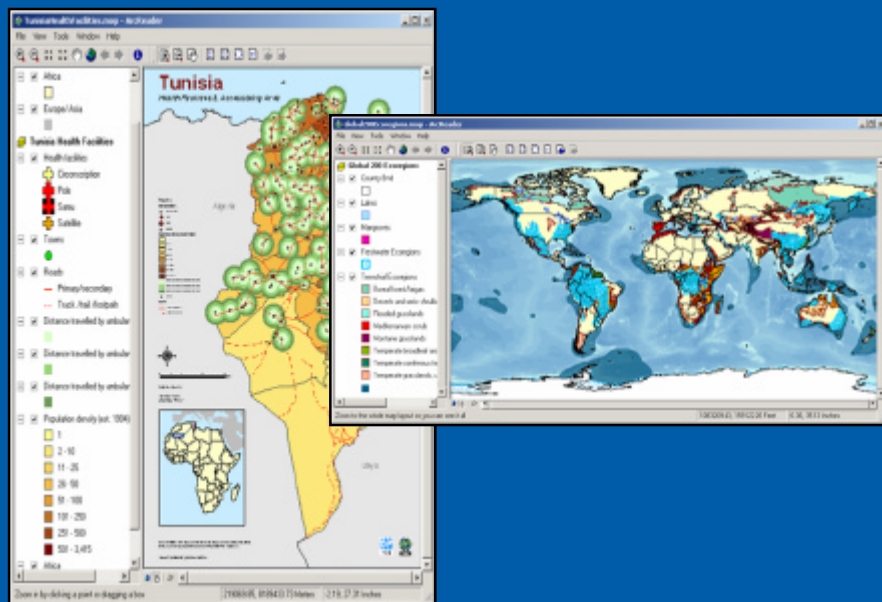
- Integrates Digital Ink
- Create Notes
- Sketch Diagrams
- Tie to Geographic Location
- Highlight Features
- Text Recognition
- Free to ArcGIS Users

ArcReader

Free Map and Data Viewer

- Cross-platform
- Access to all ArcGIS Data Sources
- Customize and Embed in any application

ArcReader: Out-of-box Viewer

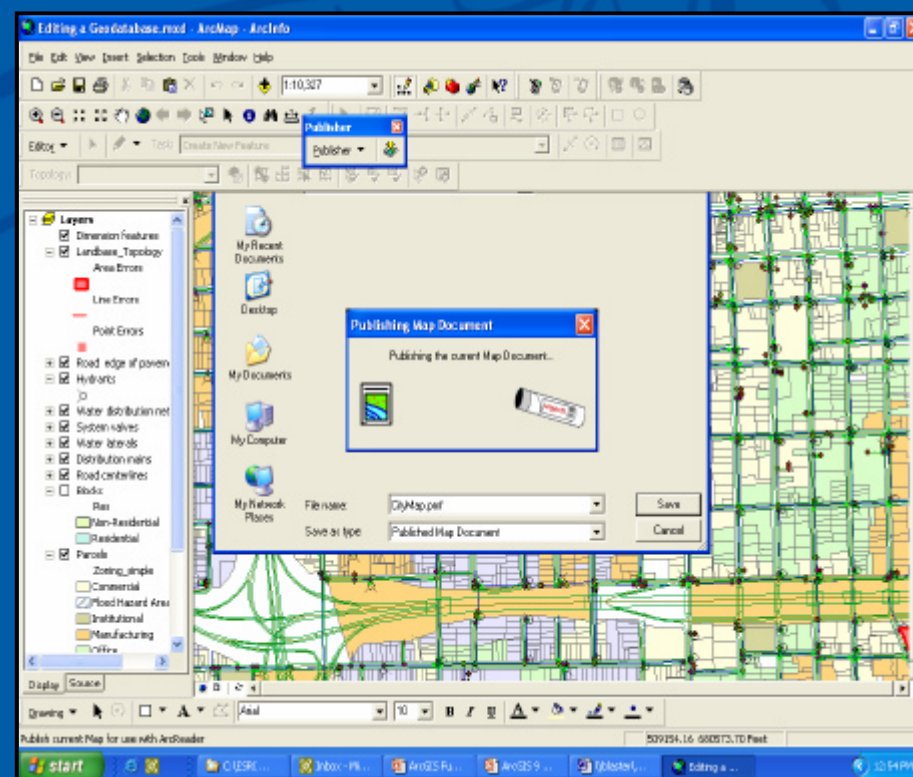


Embeddable ArcReader Developer's Kit in ArcGIS Publisher

ArcGIS Publisher

Publish PMF's & Build Custom ArcReaders

- Publish PMF's
- Package and Compress Datasets
- Encrypt data
- Developer Kit
- Windows, Sun, and Linux



Custom ArcReader Demo

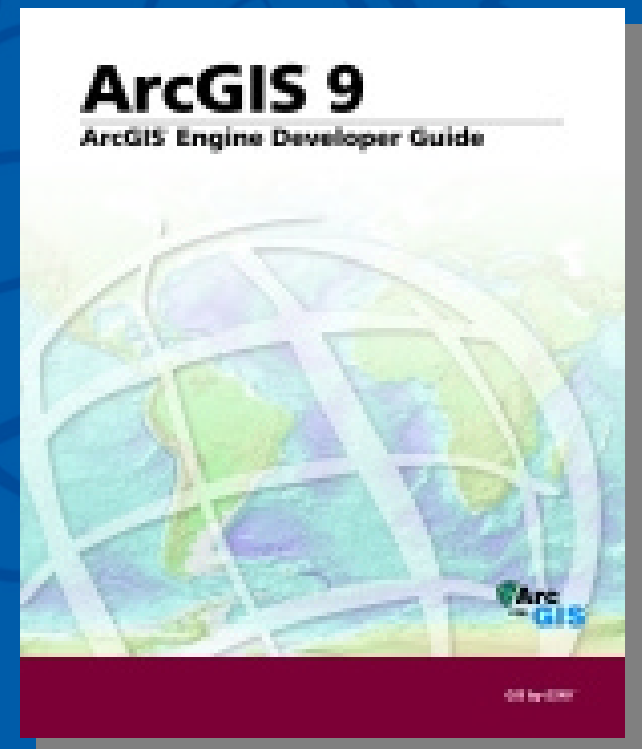
ArcEngine

ArcGIS Engine

- ArcGIS Engine Developer Kit
 - The toolkit for building and deploying custom desktop ArcObjects-based solutions (VB 6, .NET, Java, C++)
- ArcGIS Engine Runtime
 - The platform for running cross platform custom desktop solutions built with the Engine Developer Kit

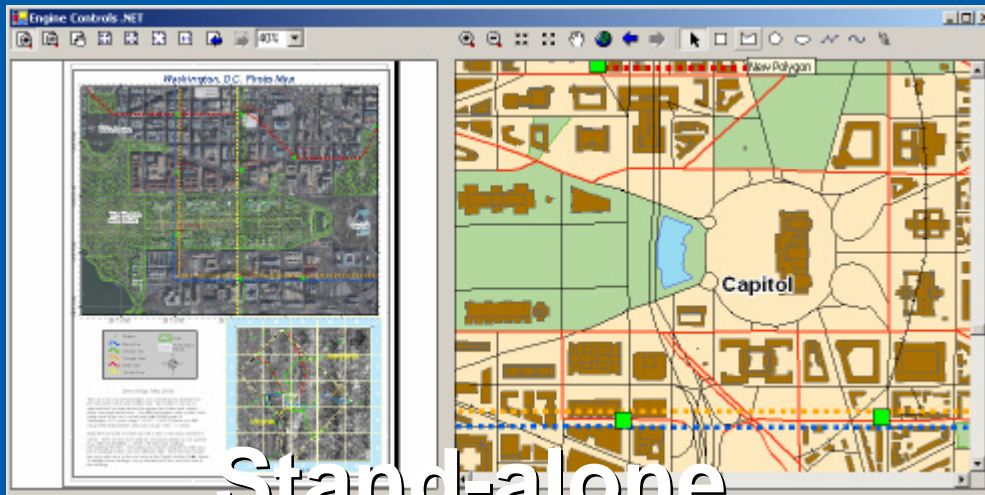
ArcGIS Engine Developer Kit

- Engine ArcObjects support for
 - COM, .NET, Java, and C++
- Developer controls
- Developer resources
 - Help, doc, samples, etc.
- Engine Runtime for testing

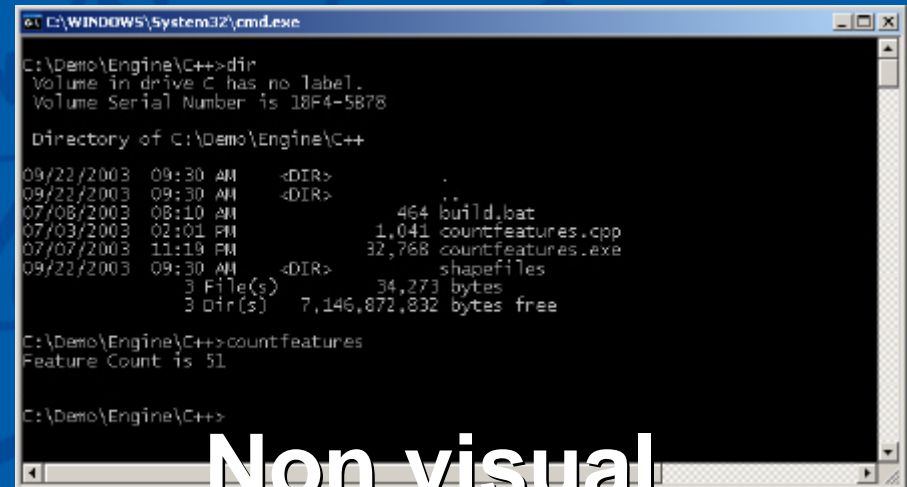


Product for Developers

Types of Engine Solutions



Stand-alone



Non visual



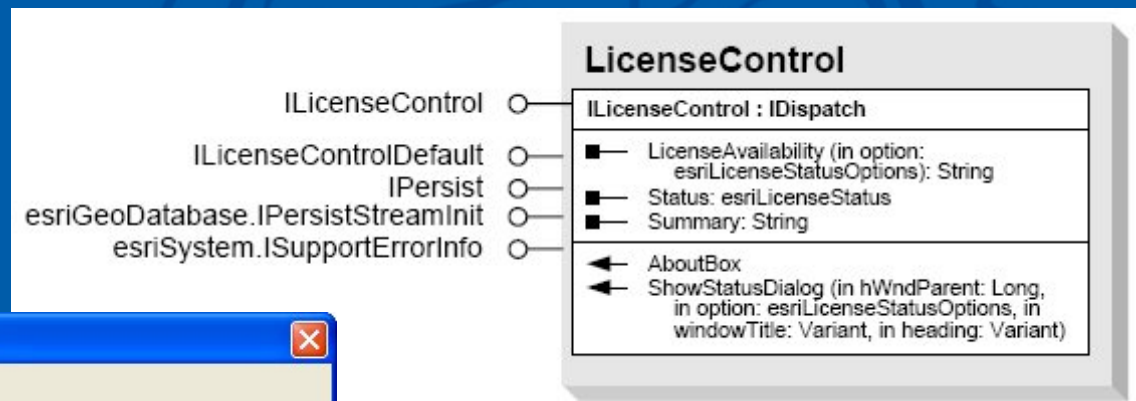
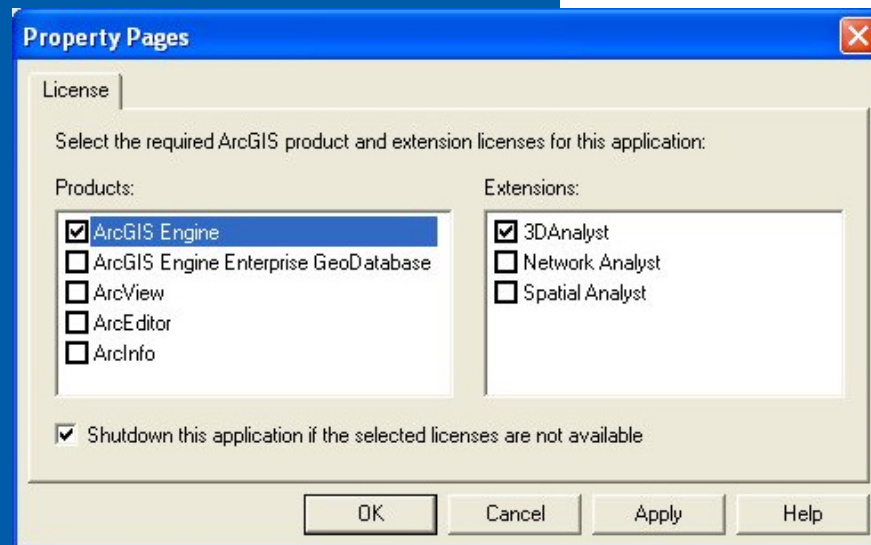
Embedded applications

ArcGIS Engine controls

- Mapping Controls: MapControl and PageLayoutControl
- Framework Controls: TOCControl and ToolbarControl
- Reader Control: ReaderControl
- Licensing Control

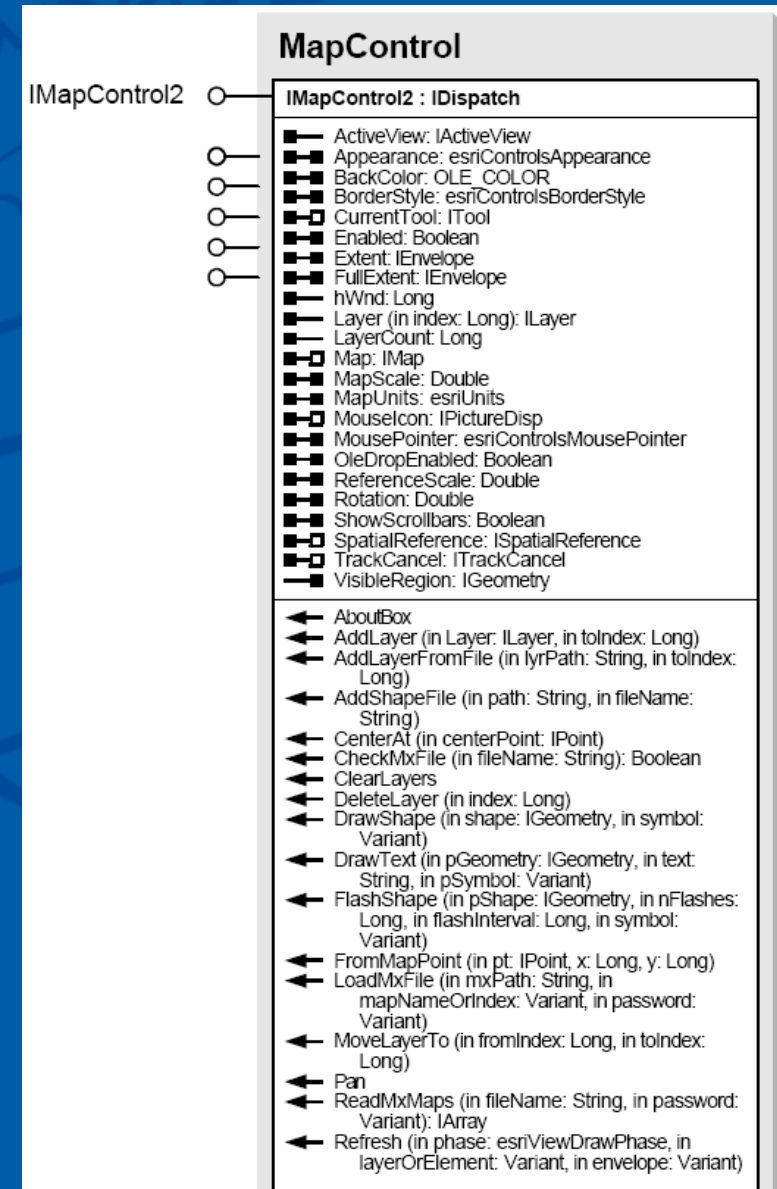
LicenseControl

- Automatically performs license initialization and shutdown
- Use property pages to set
 - Product
 - Extension



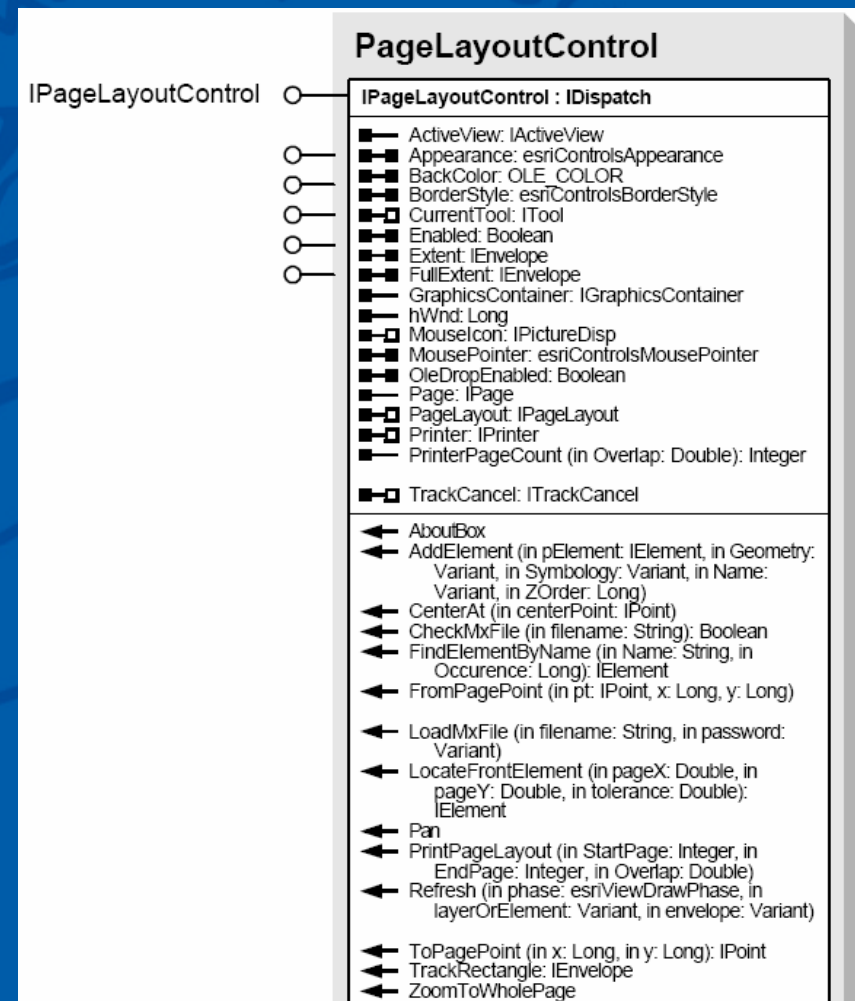
The MapControl

- MapControl
 - Encapsulates the Map coclass
 - Draws a single data frame
 - Used for analysis and viewing
 - Exposes mouse and drawing events
 - Loads map documents and other files



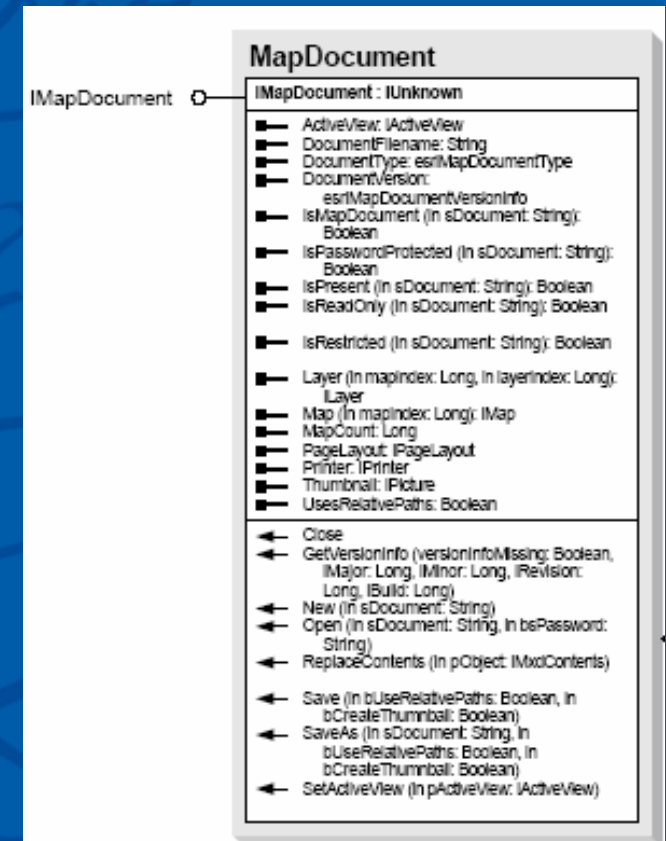
The PageLayoutControl

- PageLayoutControl
 - Encapsulates the PageLayout coclass
 - Draws all elements in one view
 - Creates layouts
 - Printing
 - Sets the current tool
 - Loads map documents



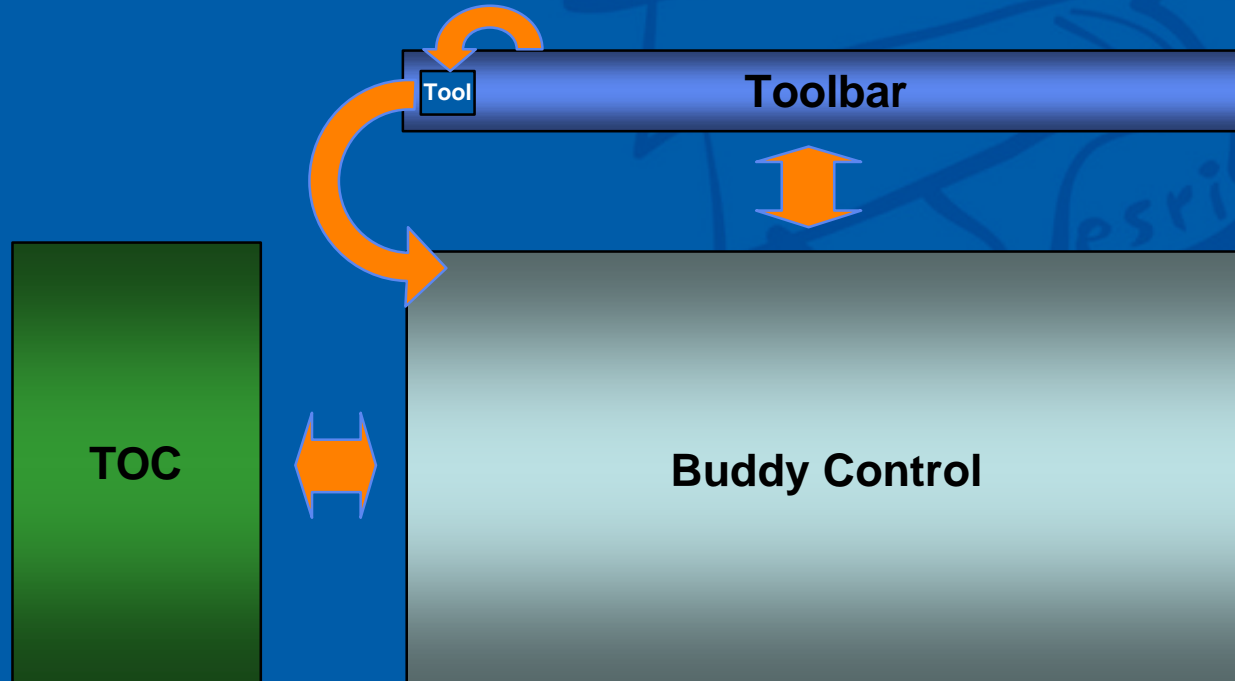
Working with Map Documents

- MapDocument makes it possible to
 - Read .mxd, .lyr, .mxt, and .pmf files
 - Write new .mxd files
 - Access the contents of a map document
- Generally authored using ArcMap



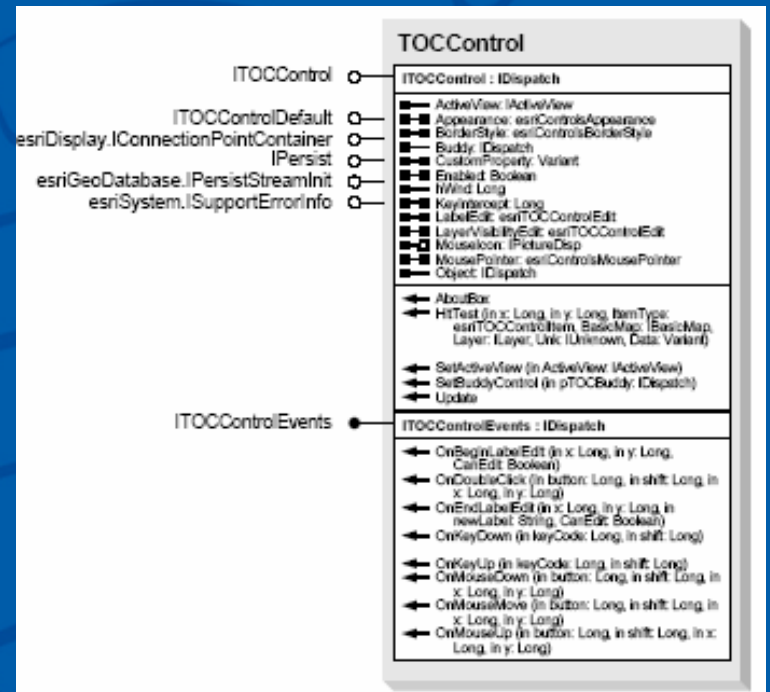
The Framework Controls

- ToolbarControl and TOCControl are designed to work with all other controls
- Communicate and synchronize with each other
- Tied together through a buddy control



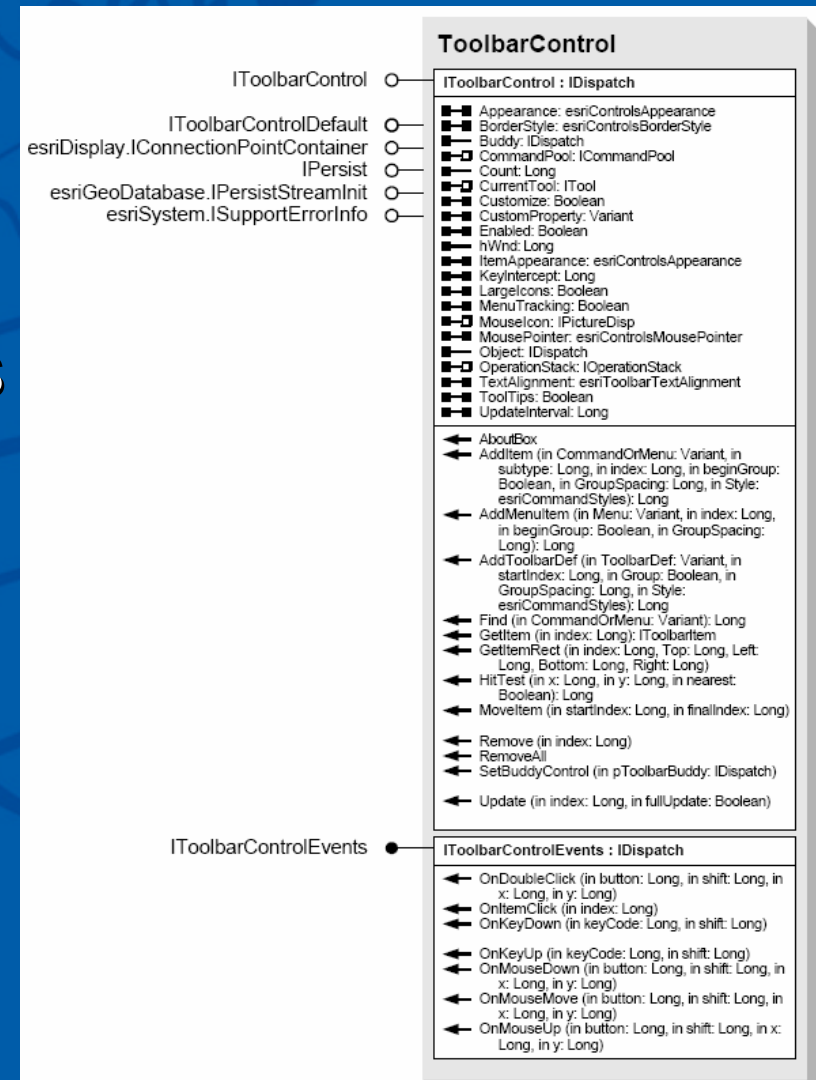
TOCCControl

- Displays all layers and symbols for a control
- Controls layer visibility
- Must call SetBuddyControl
- Limitations
 - No property pages, can't reorder layers, no default context menus...



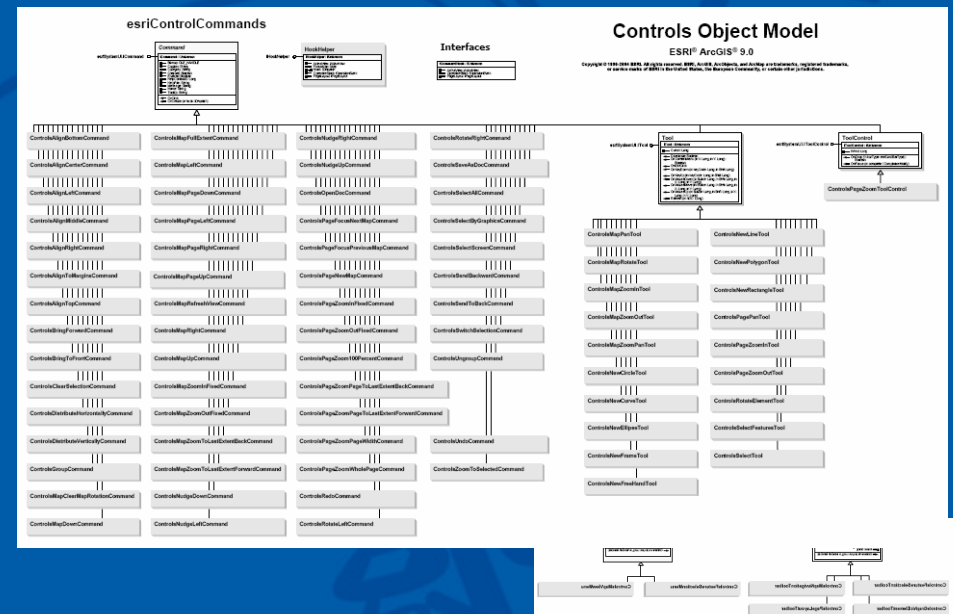
ToolbarControl

- Container for custom commands, tools, and menus
- Allows commands to interact with the objects in the controls
 - Map, PageLayout, Scene, and Globe
- Must call SetBuddyControl



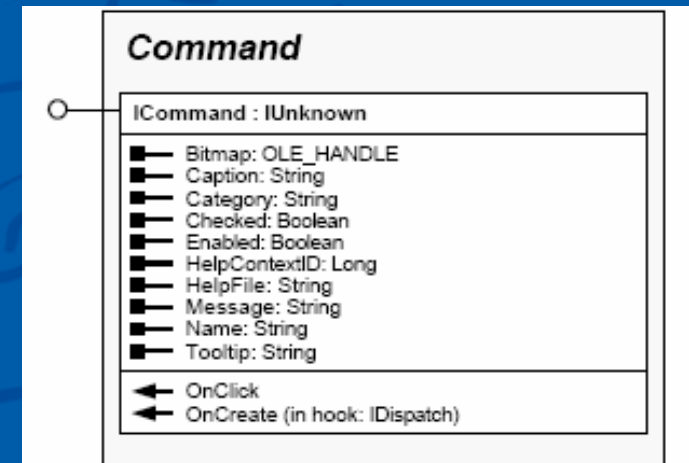
The Mapping Control Commands

- Prewritten commands, tools, toolbars, and menus for the controls
- Commands and tools
 - Pan, zoom, open documents, graphics, etc
- Toolbars
 - Feature selection, graphics, map navigation, and page layout
- Menus
 - Feature selection and map view
- Library
 - `esriCommandControls.olb`
- References
 - OMD or tech docs



Implementing Custom Commands

- The framework gives you the ability to create custom commands
- Added seamlessly to ToolbarControl



- Steps
 1. Create a class
 2. Implement ICommand
 3. Add the class to the toolbar

```
Public Class ZoomToLayerClass  
    Implements ICommand
```



ArcEngine Demo: Redlining with Tablet tools

